

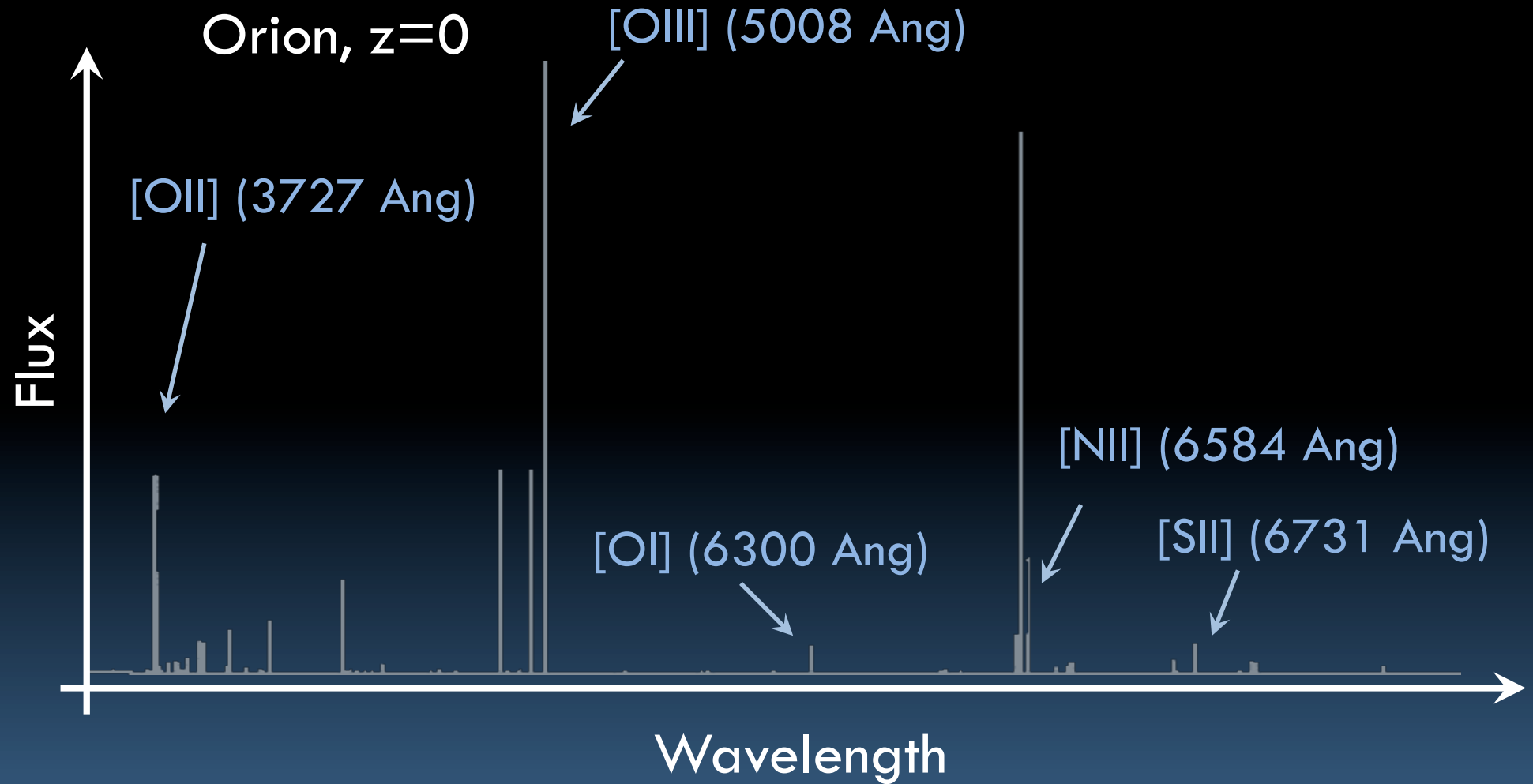


Roberto Decarli

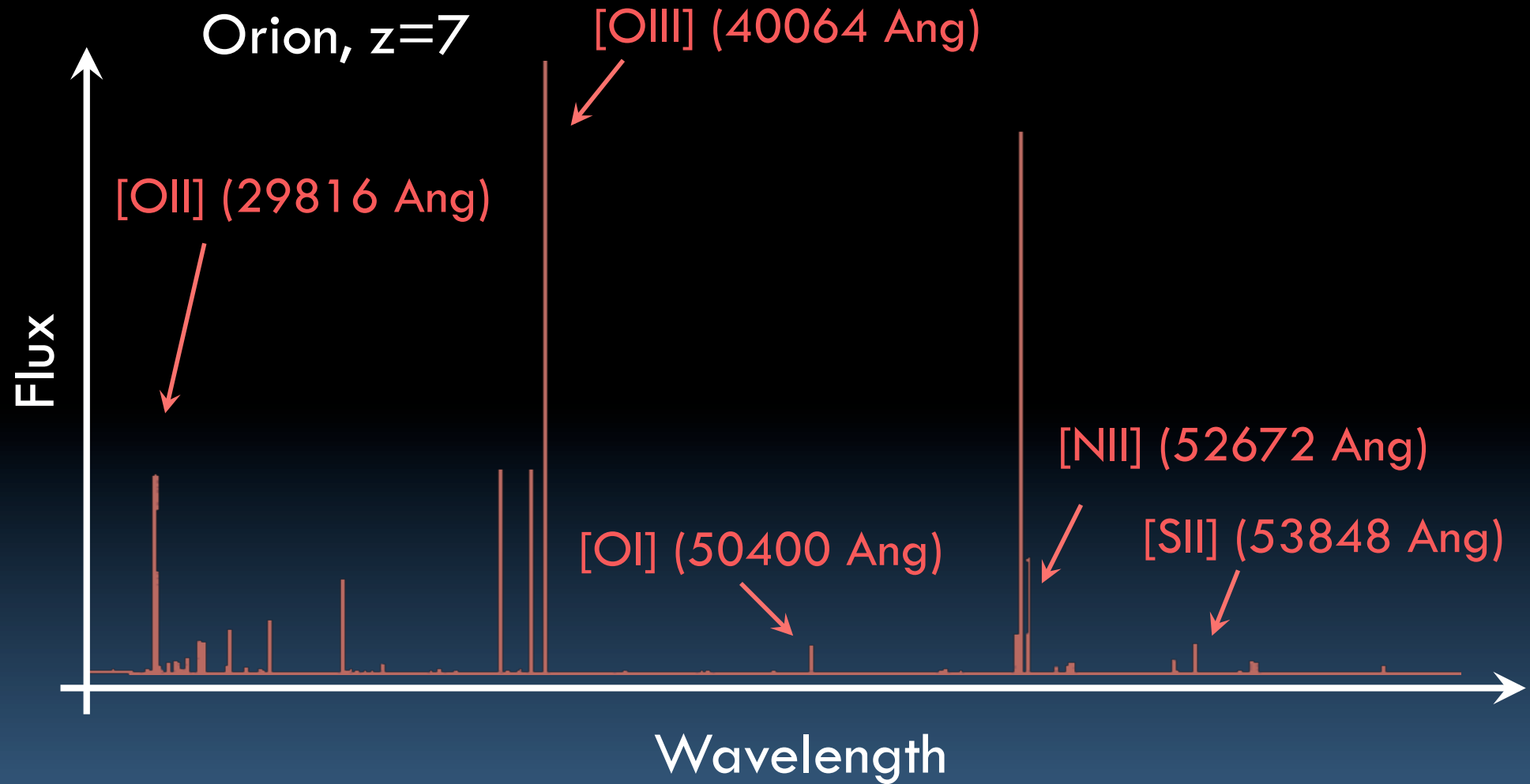
Fabian Walter, Jackie Hodge,
Elisabete da Cunha, Bram Venemans,
Livia Vallini, Jorge Gonzalez,
Axel Weiss, Dominik Riechers,
Roberto Neri, Pierre Cox,
Chris Carilli, Roberto Maiolino

THE FORBIDDEN SIDE
OF HIGH-Z UNIVERSE

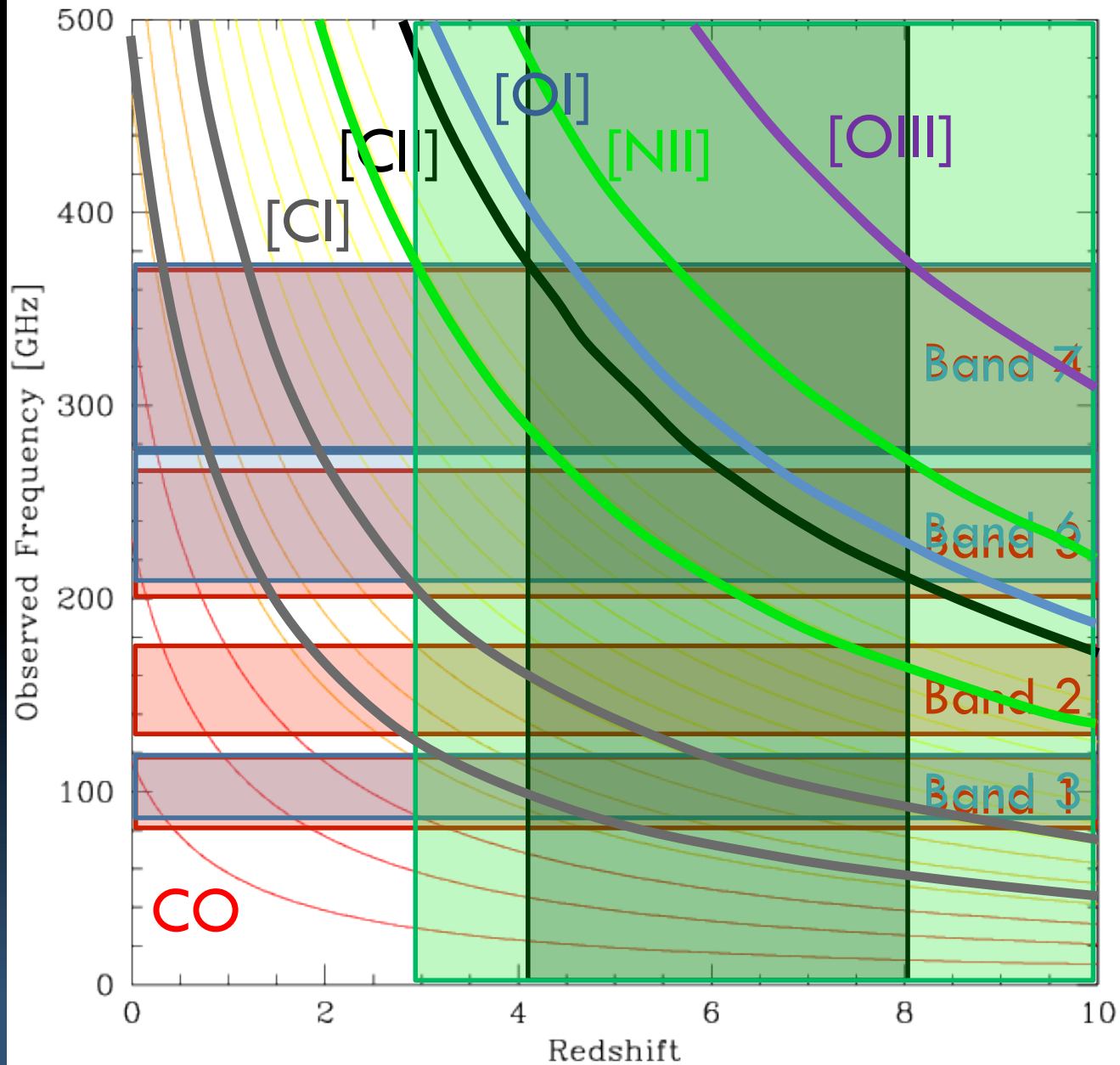
ISM PROBES AT LOW-Z



ISM PROBES AT HIGH-Z



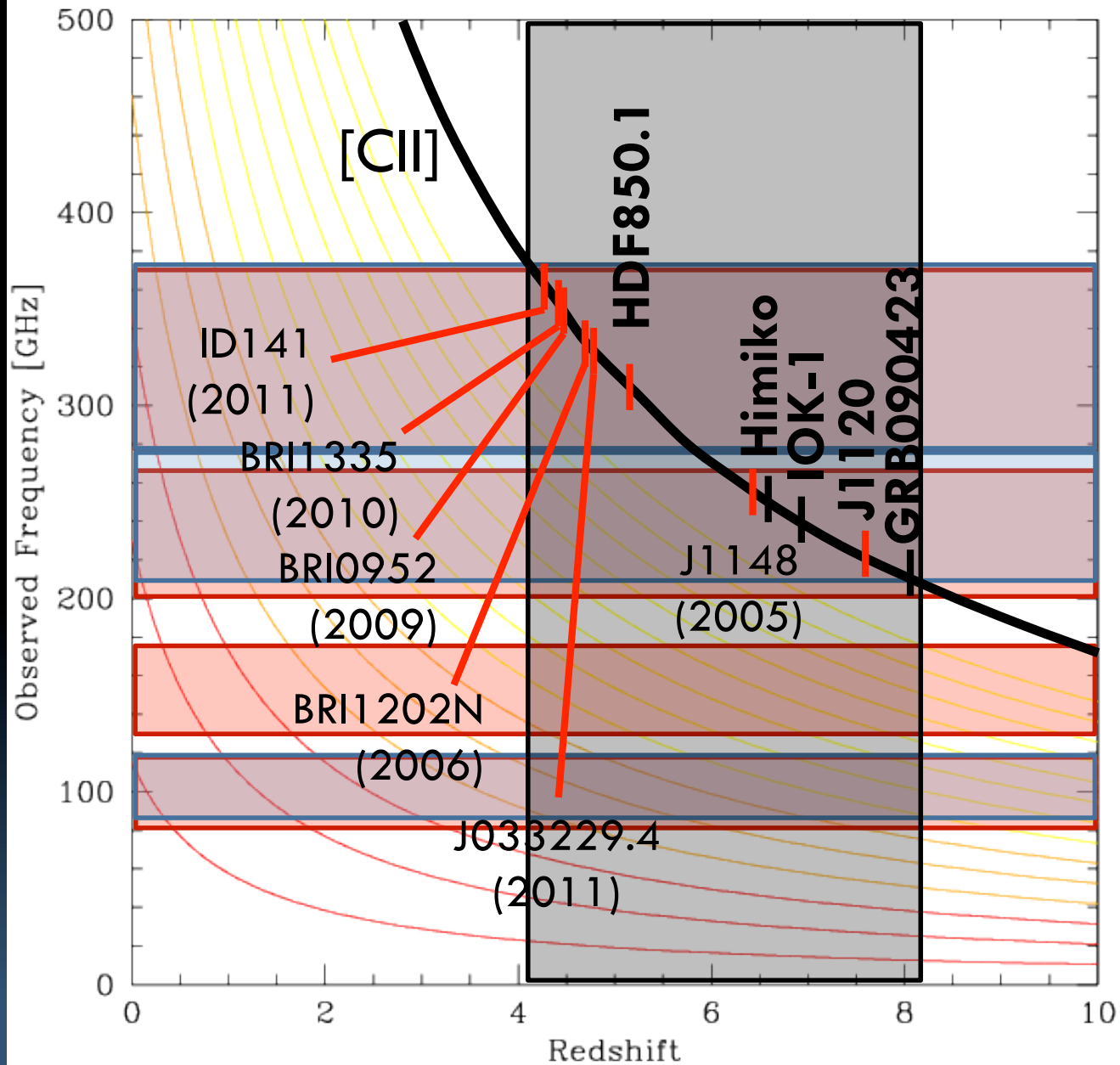
ISM PROBES AT MM WAVELENGTHS



PdBI

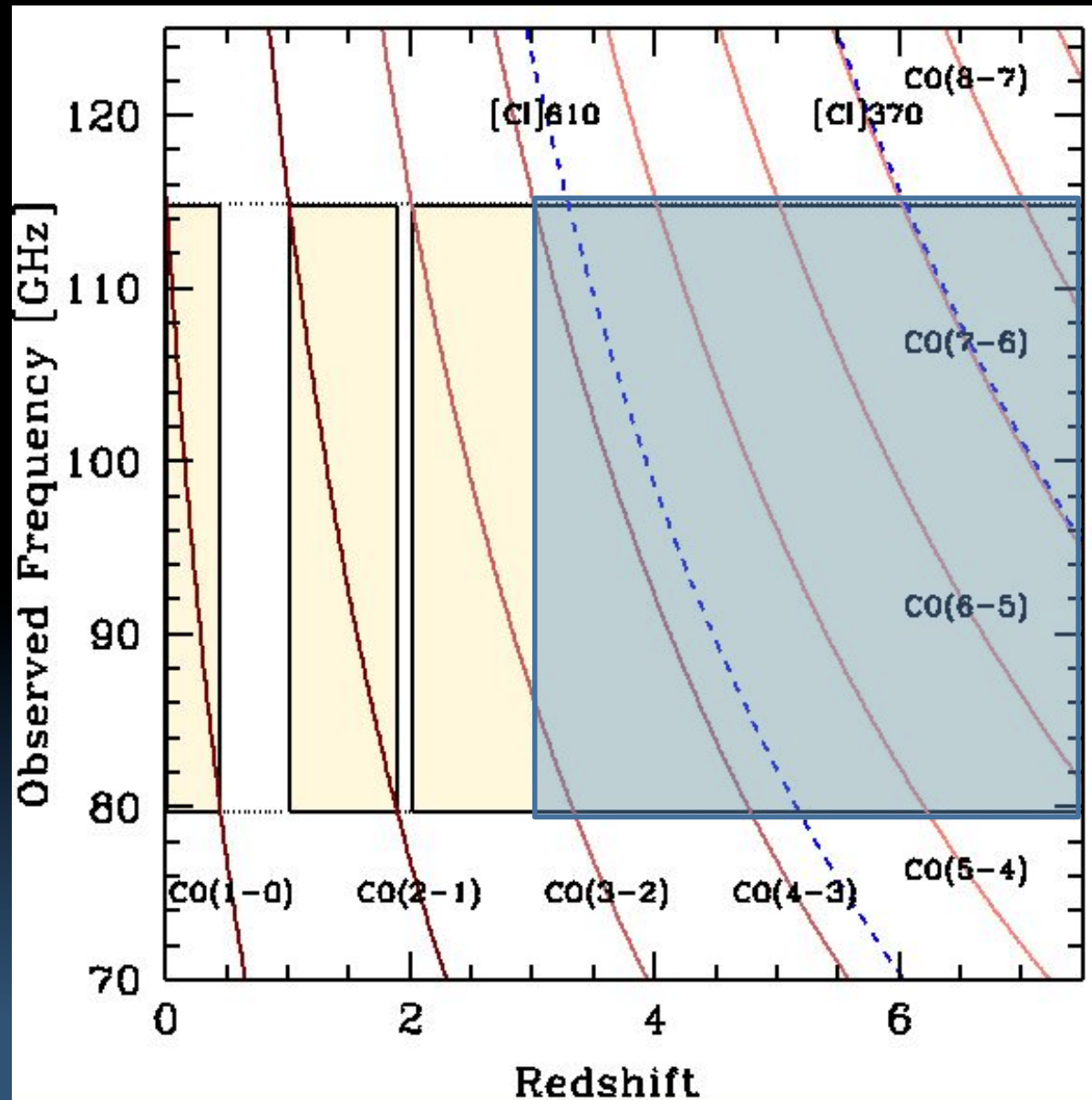
ALMA

ISM PROBES AT MM WAVELENGTHS



HDF850.1

RD, et al., in prep.

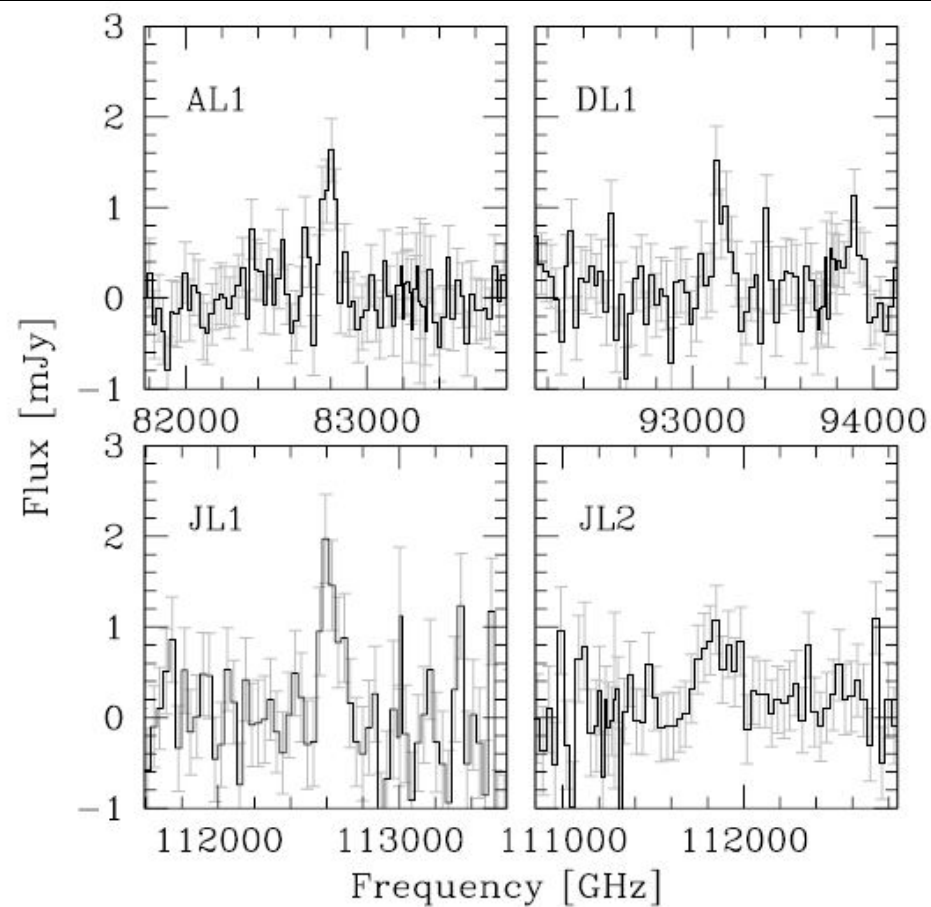
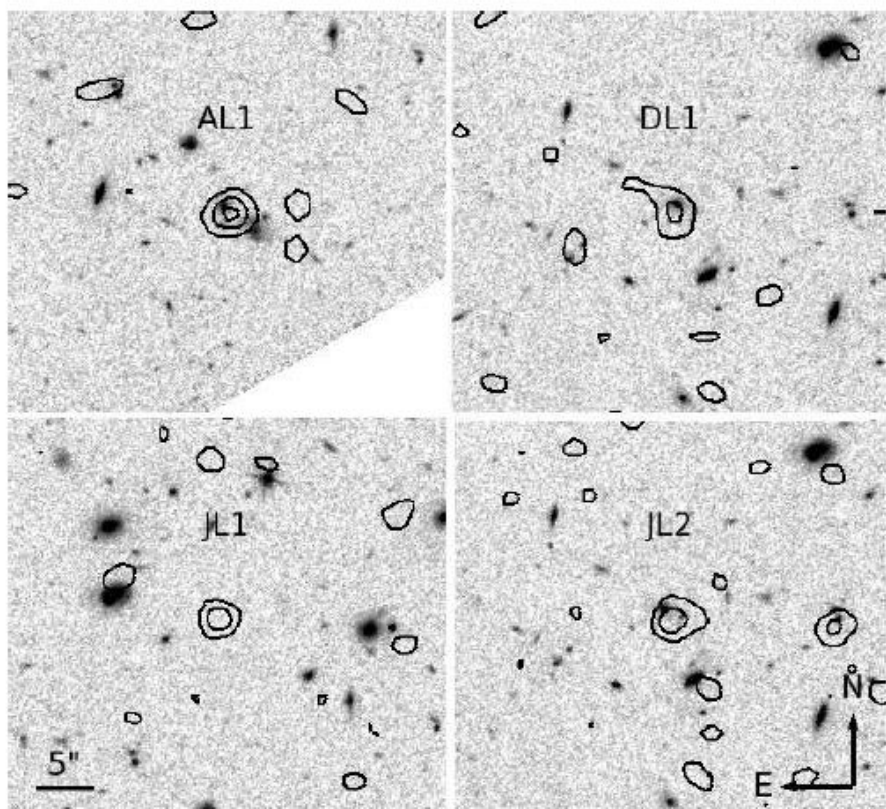


Full scan of the
3mm band on the
HDFN

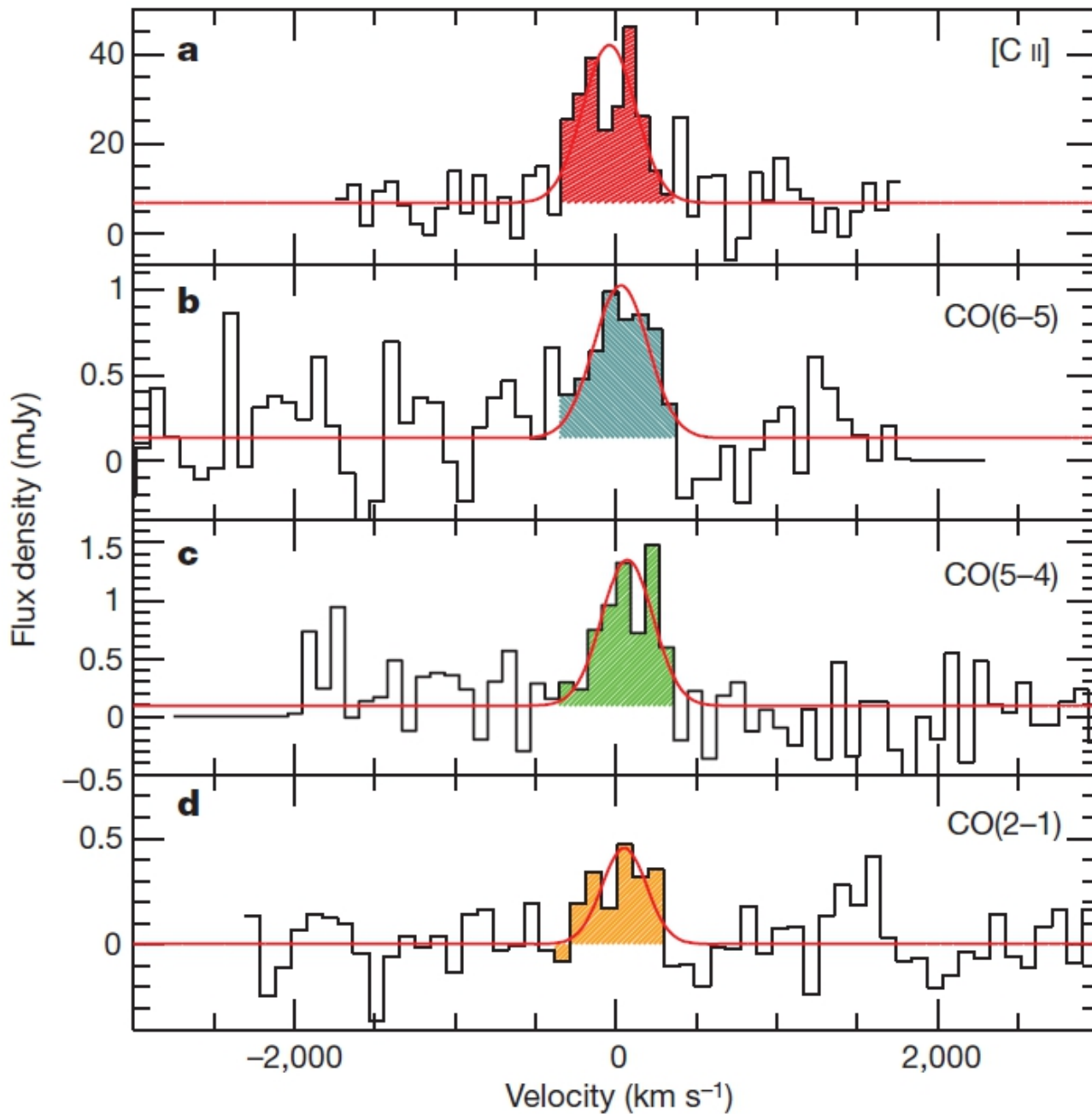
Blind CO search

11 “high-quality”
line candidates

HDF850.1



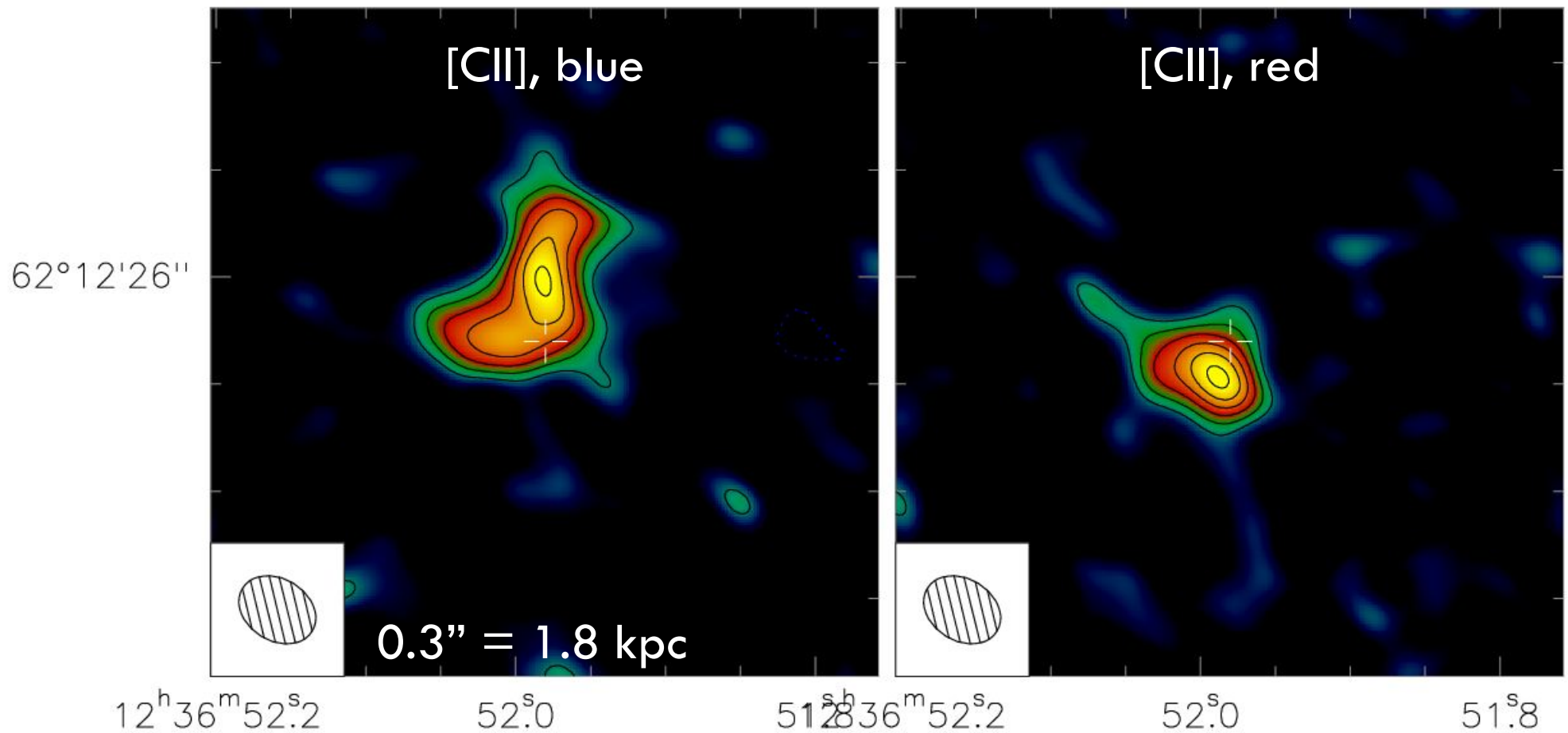
HDF850.1



**One of the
highest- z [CII]
detection in a
SMG: $z=5.183$**

Walter, RD, et al.,
(2012) Nature

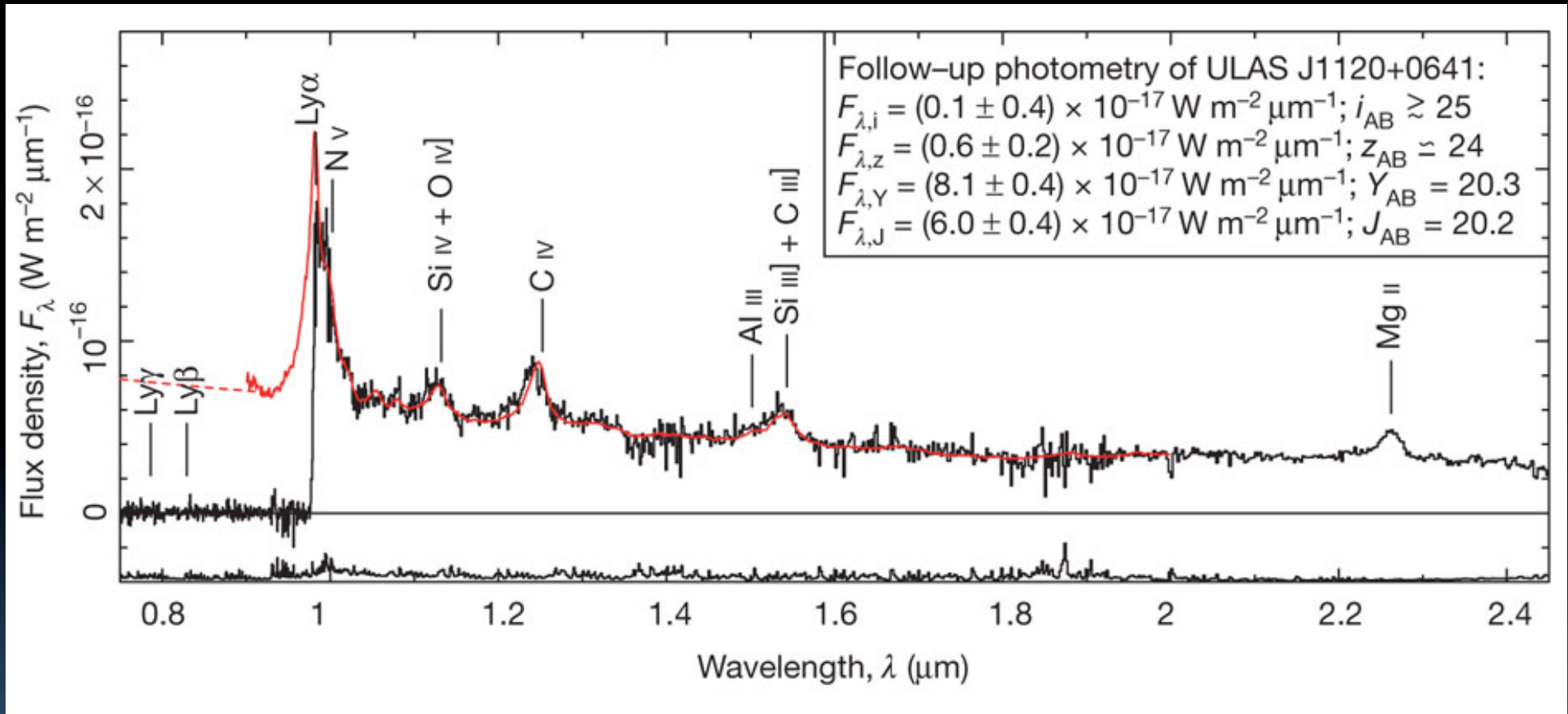
Neri et al., in prep.



0.3" res [CII] image reveals an on-going merger at $z=5.2$

J1120+0641

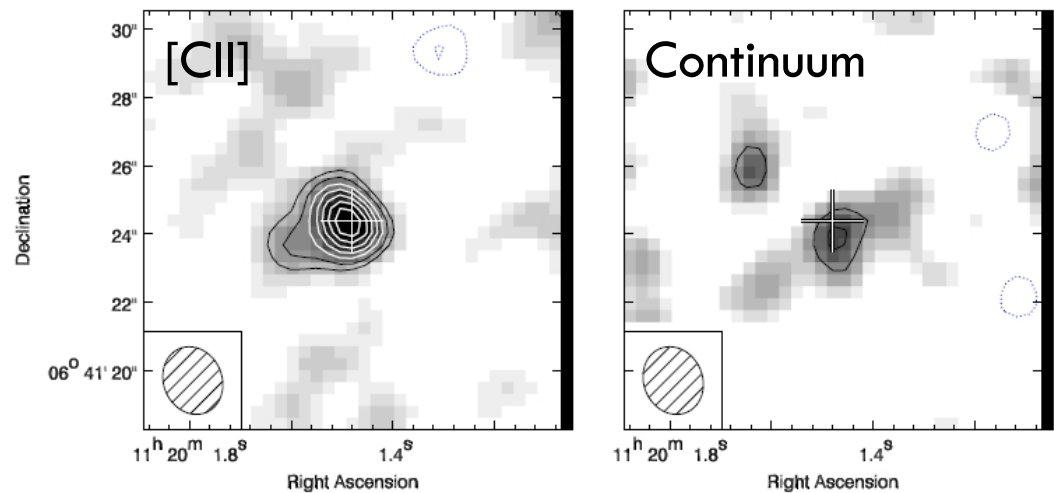
Mortlock et al., 2011



Redshift record holder (among QSOs): $z=7.085$

[CII] @ z=7.085

Venemans et al., 2012

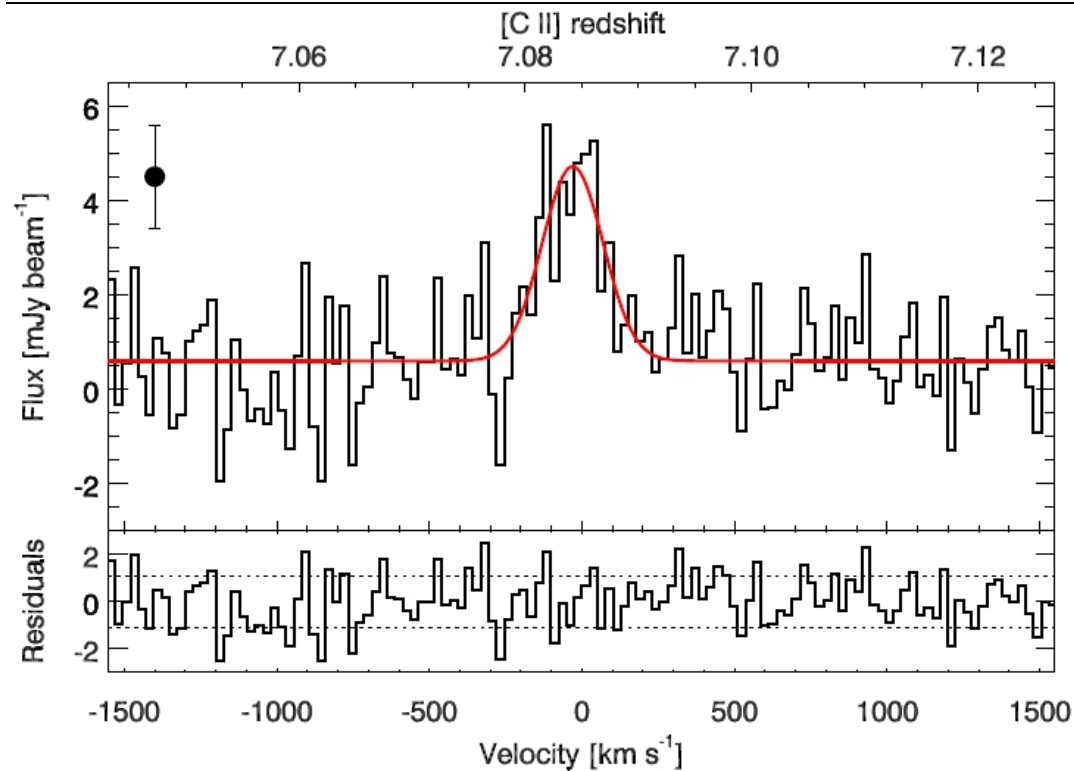


Most distant [CII]
detection

SFR $\sim 160\text{-}440 M_{\odot}/\text{yr}$

$M_{\text{dust}} \sim 7\text{-}60e7 M_{\odot}$

$M_{\text{dyn}} < 1.4e11 M_{\odot}$

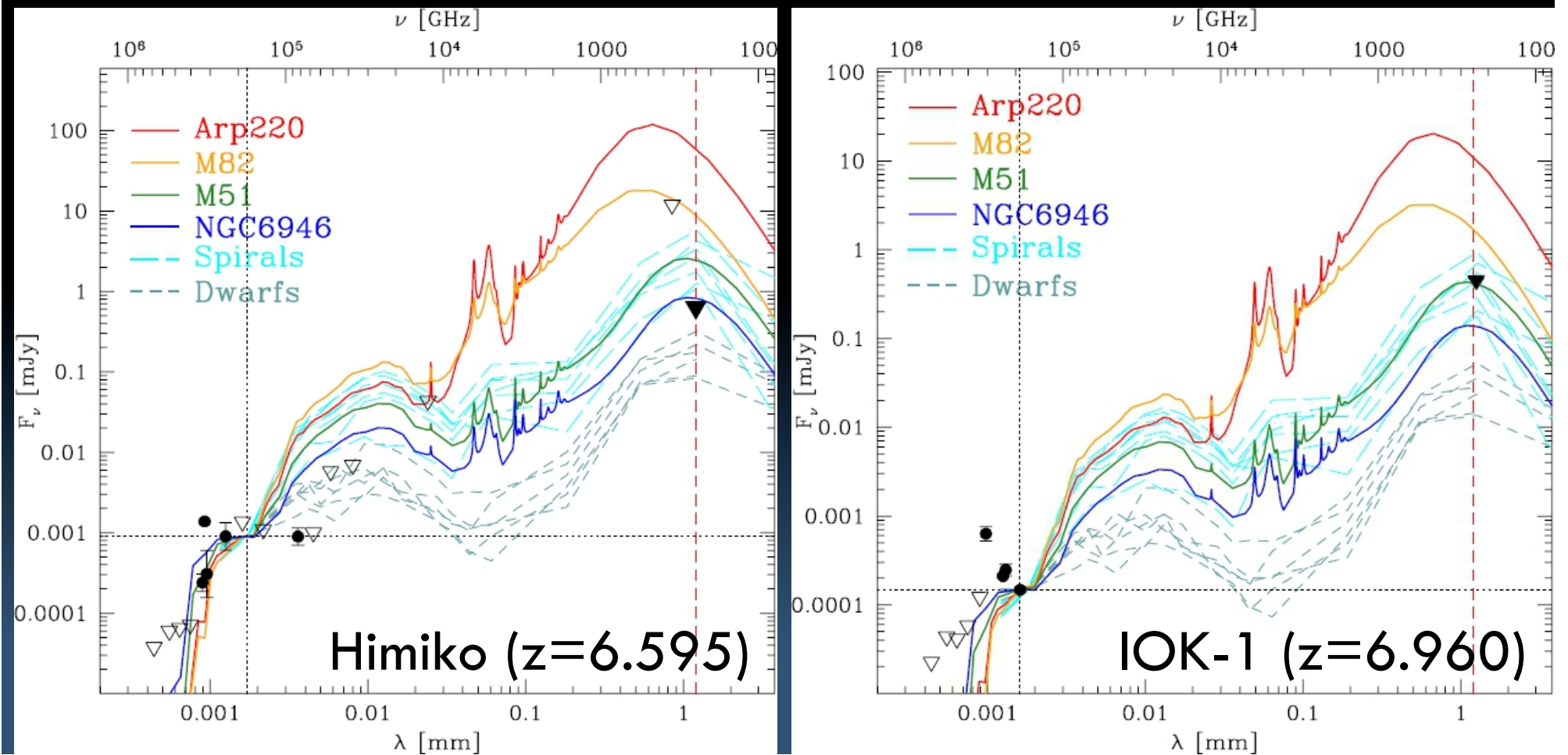


[CII] IN LAES AND GRB HOSTS

No continuum / [CII] detection

$SFR_{FIR} < 40-70 M_{\odot}/yr$ (3- σ) $\sim 2-3 \times SFR_{UV}$ (uncorr.)

Walter et al., 2012; Gonzalez et al., in prep.

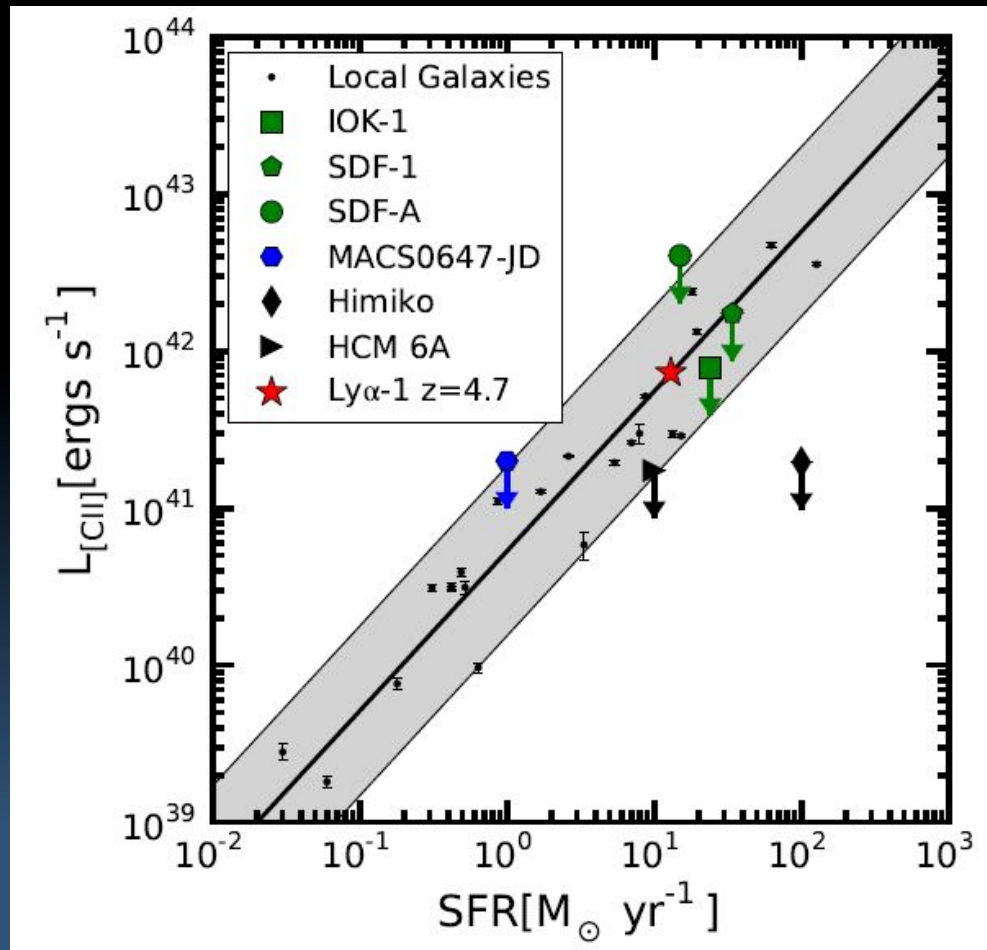


[CII] IN LAES AND GRB HOSTS

No continuum / [CII] detection

$$\text{SFR}_{\text{FIR}} < 40\text{-}70 M_{\odot}/\text{yr} \text{ (3-}\sigma) \sim 2\text{-}3 \times \text{SFR}_{\text{UV}} \text{ (uncorr.)}$$

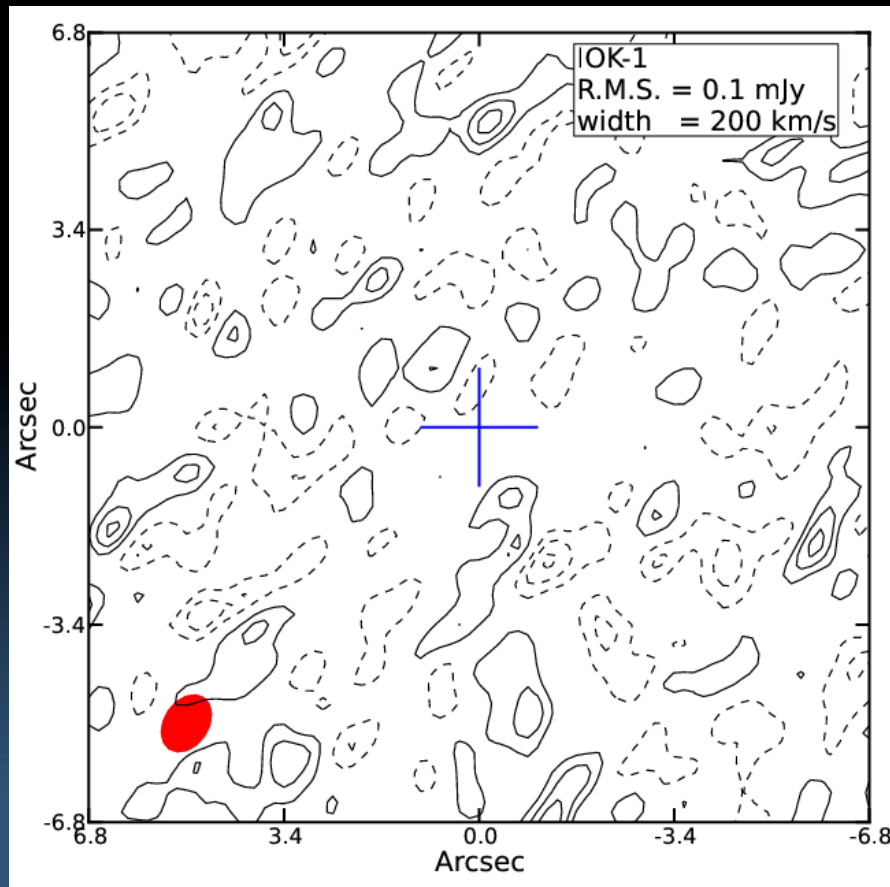
Walter et al., 2012; Gonzalez et al., in prep.



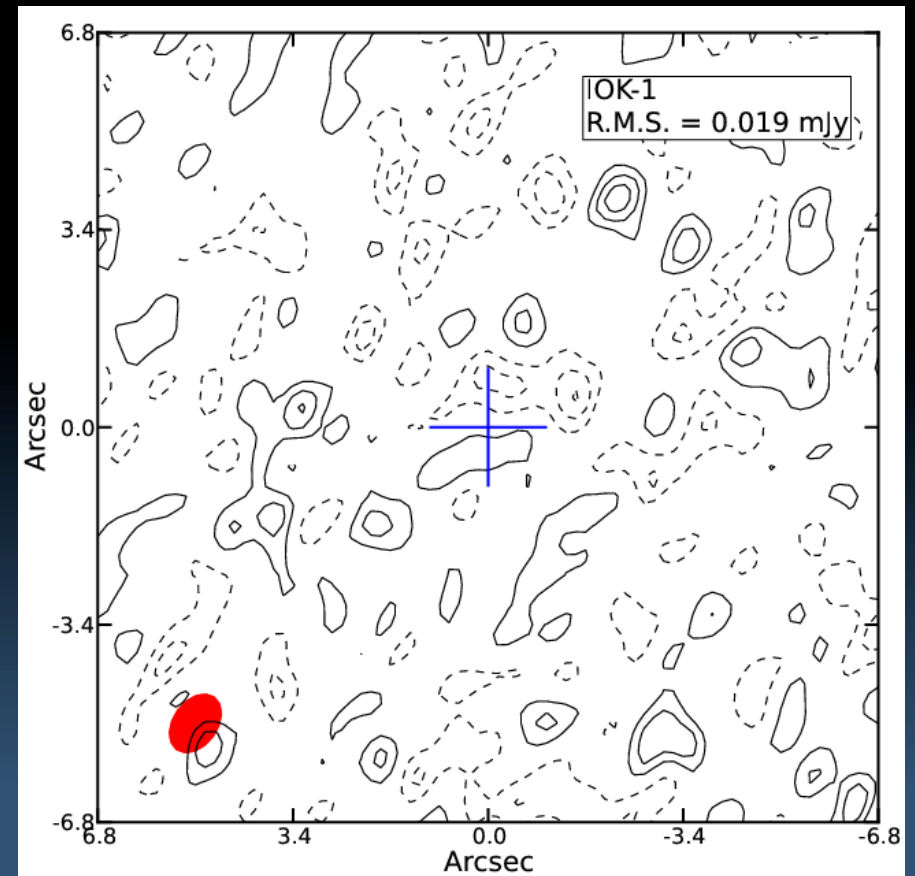
NOT EVEN WITH ALMA??

ALMA observations of IOK-1 (PI: Ota)
(see also Uchi et al. 2013 on Himiko)

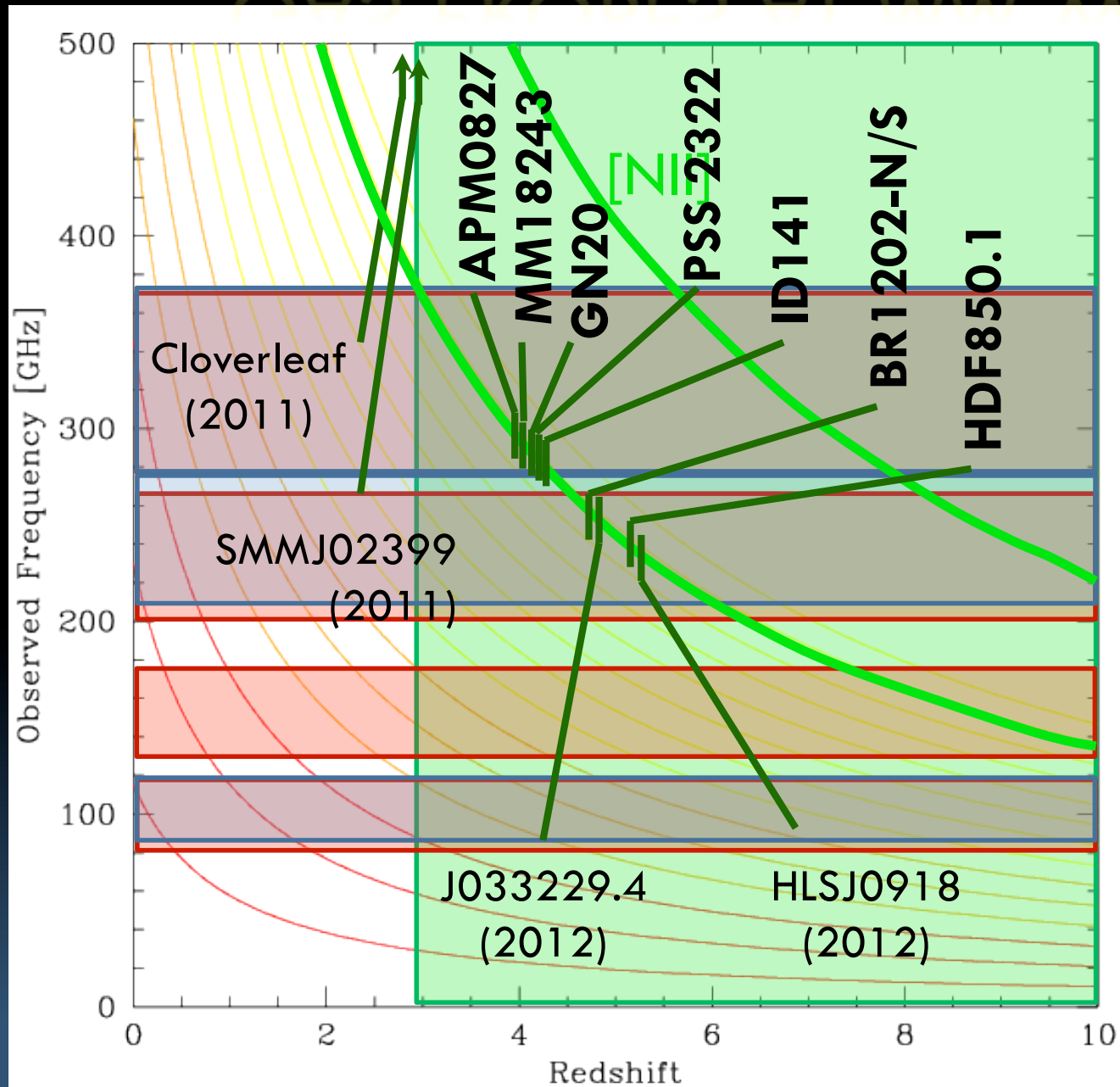
Line

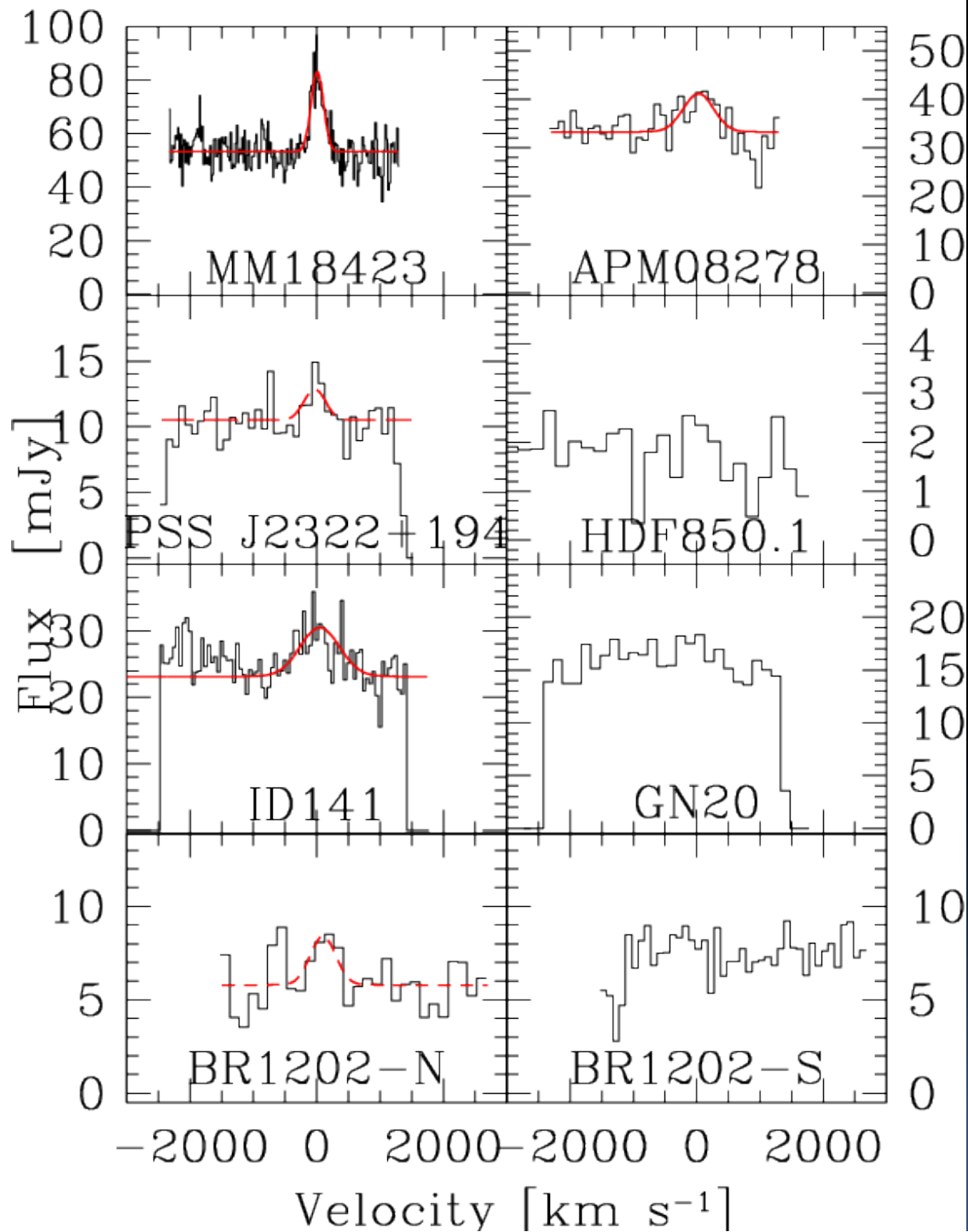


Continuum



GAS PROBES AT MM WAVELENGTHS



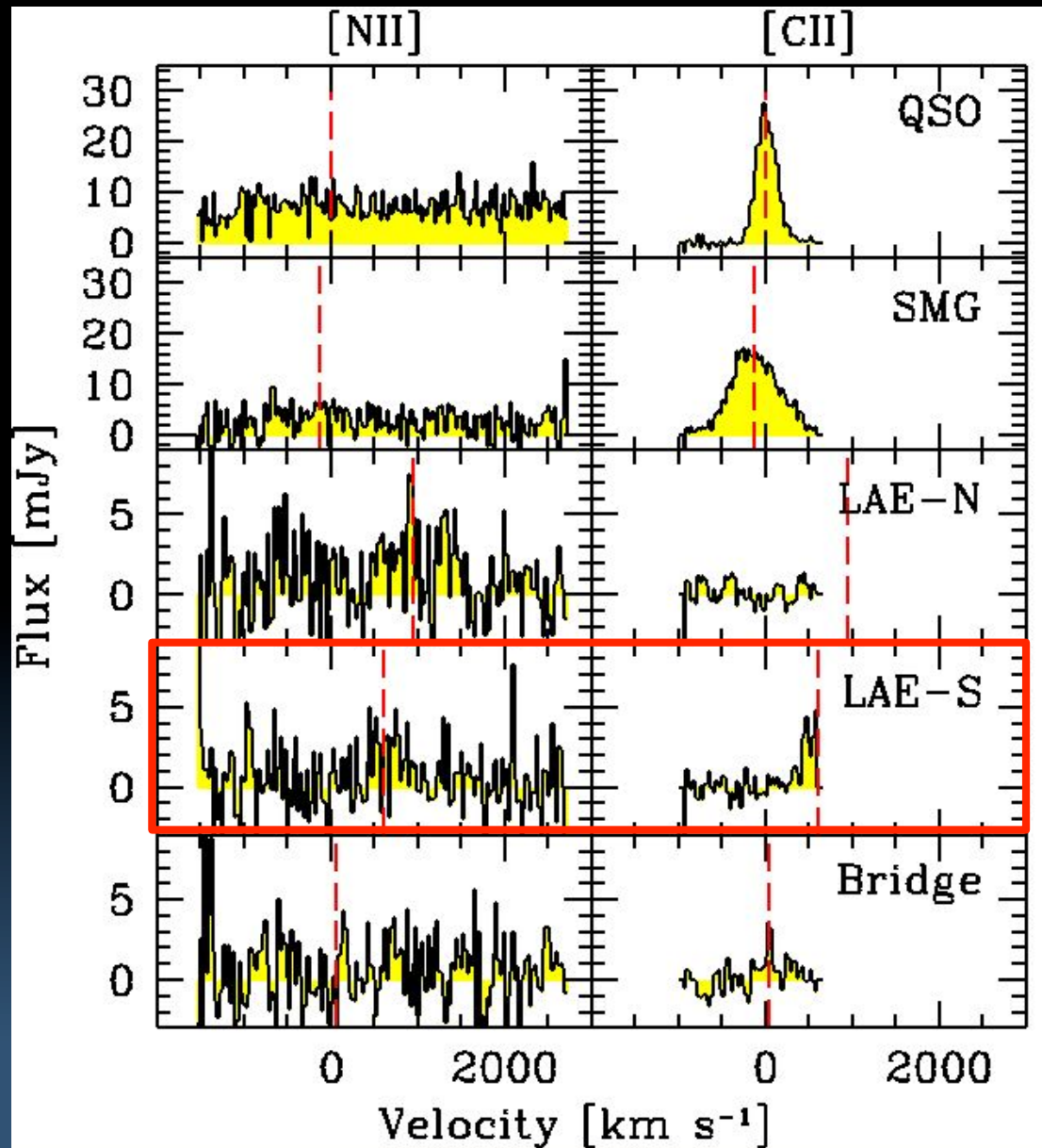


[NII] AT HIGH-Z

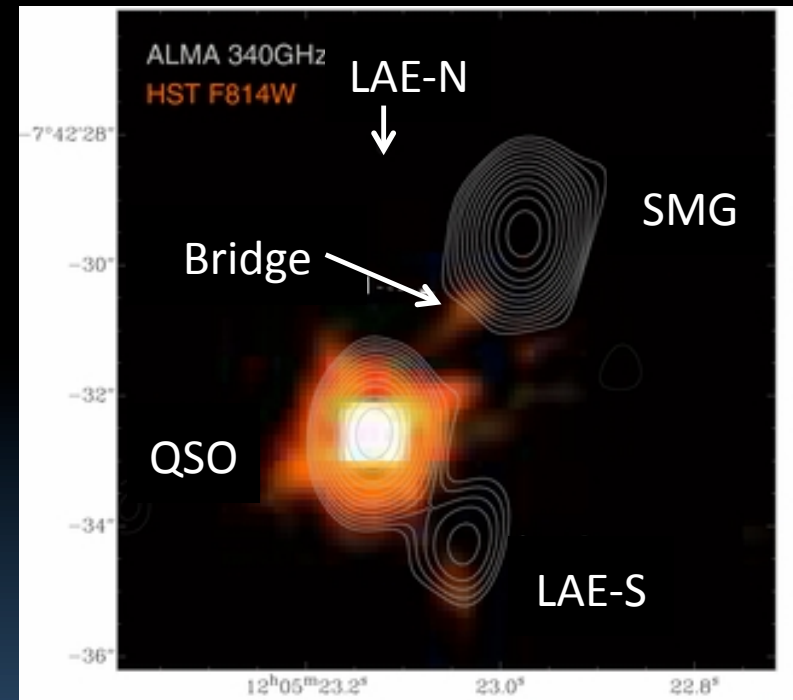
Targeted [NII]
where feasible

[NII] detected in 5
sources (out of 8)

BR1202-0725



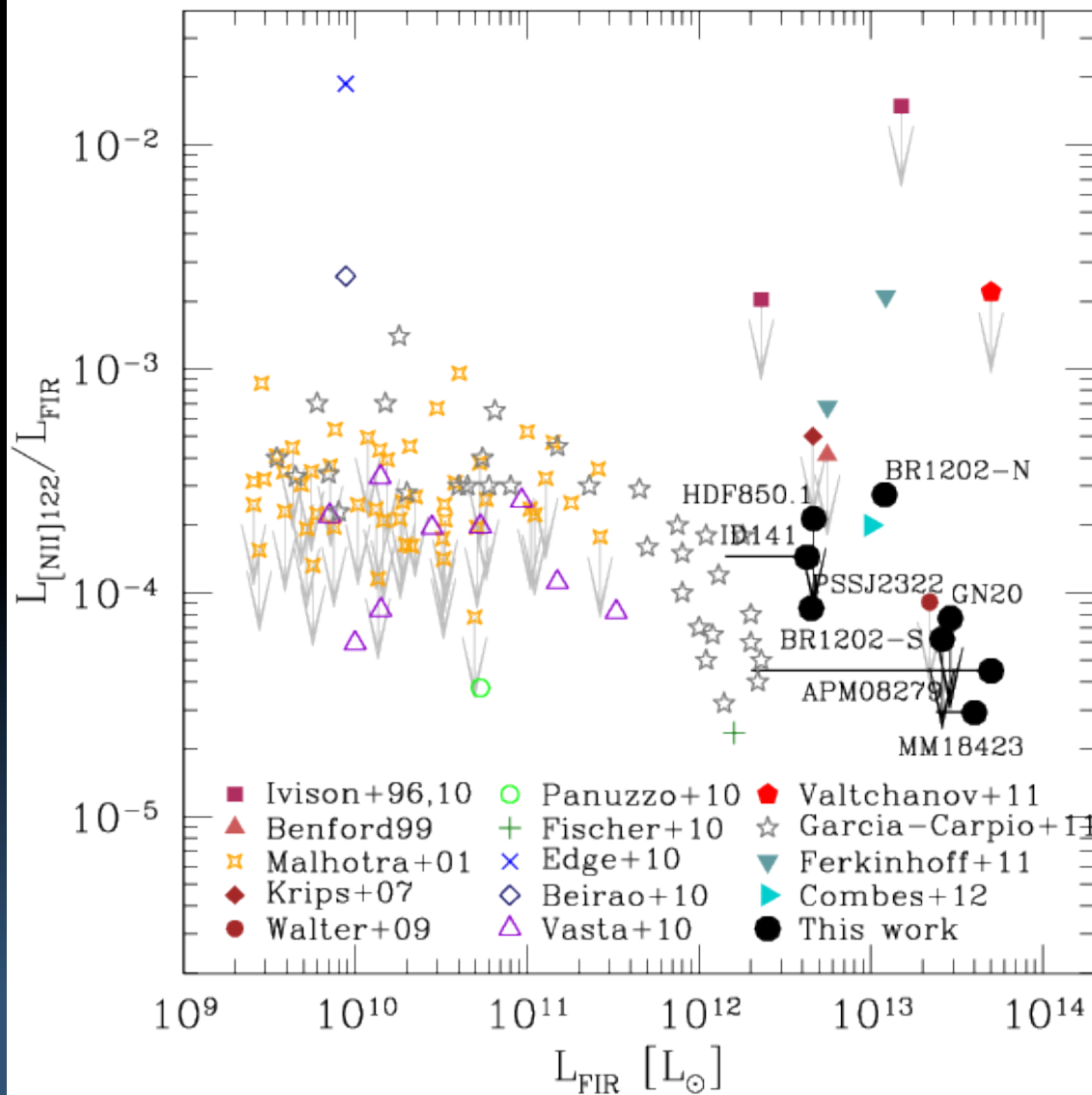
Carilli et al. 2013



Decarli et al. 2013

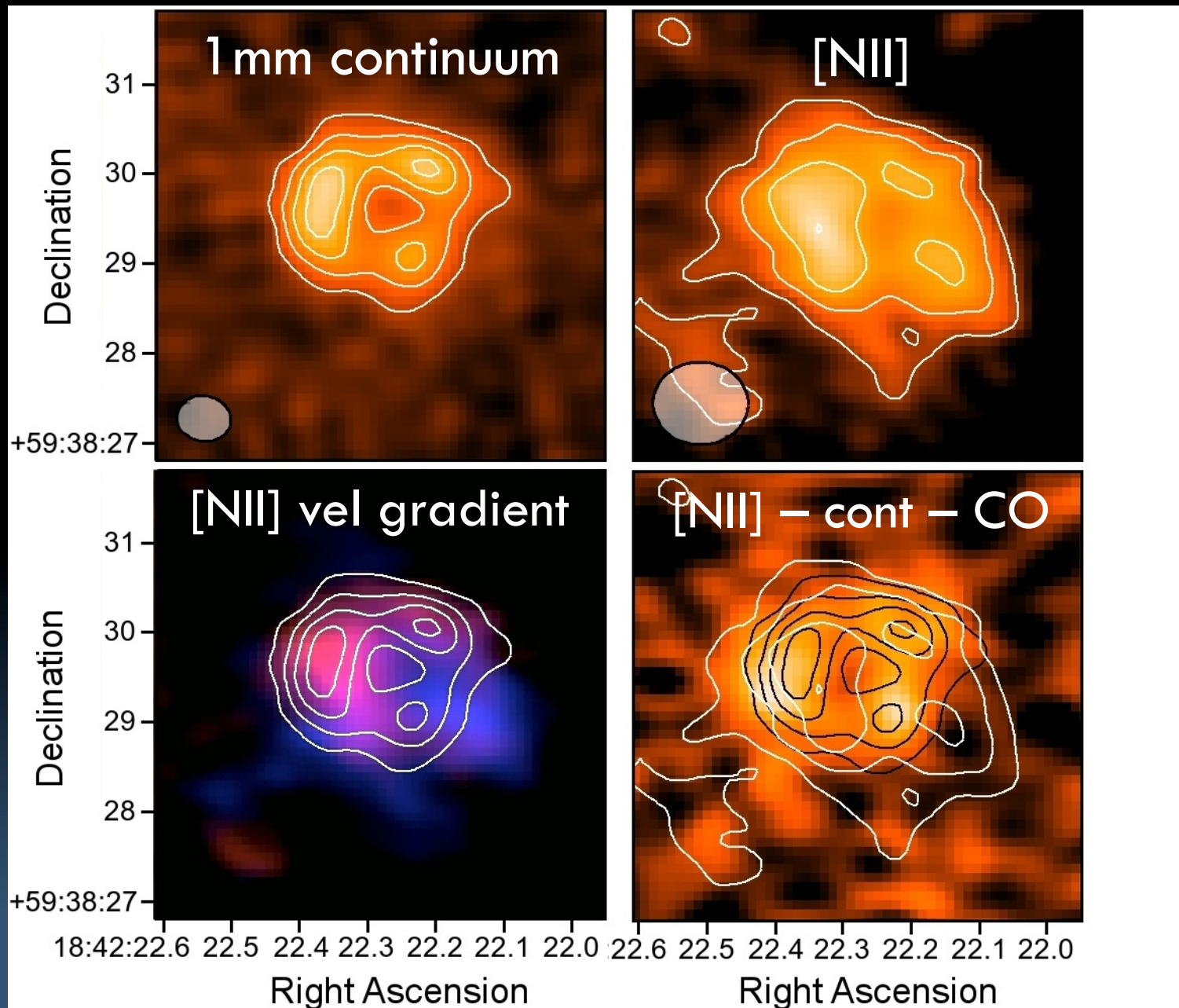
[NII] COOLING

Decarli et al. 2012,13



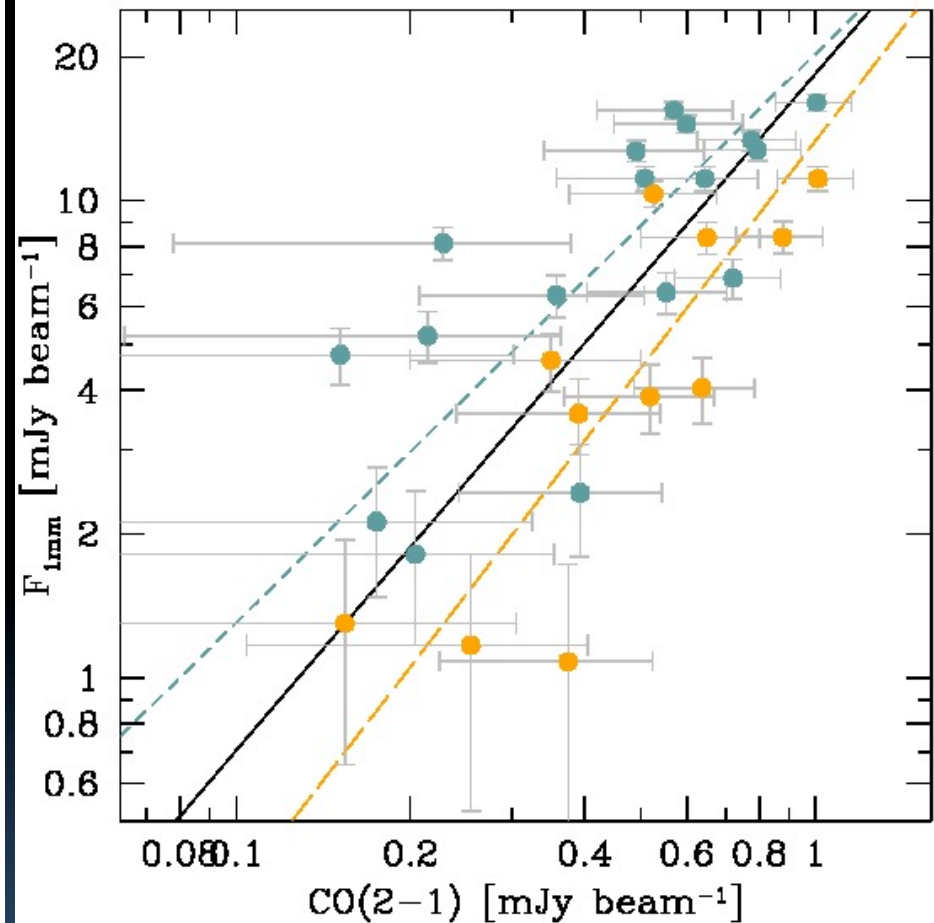
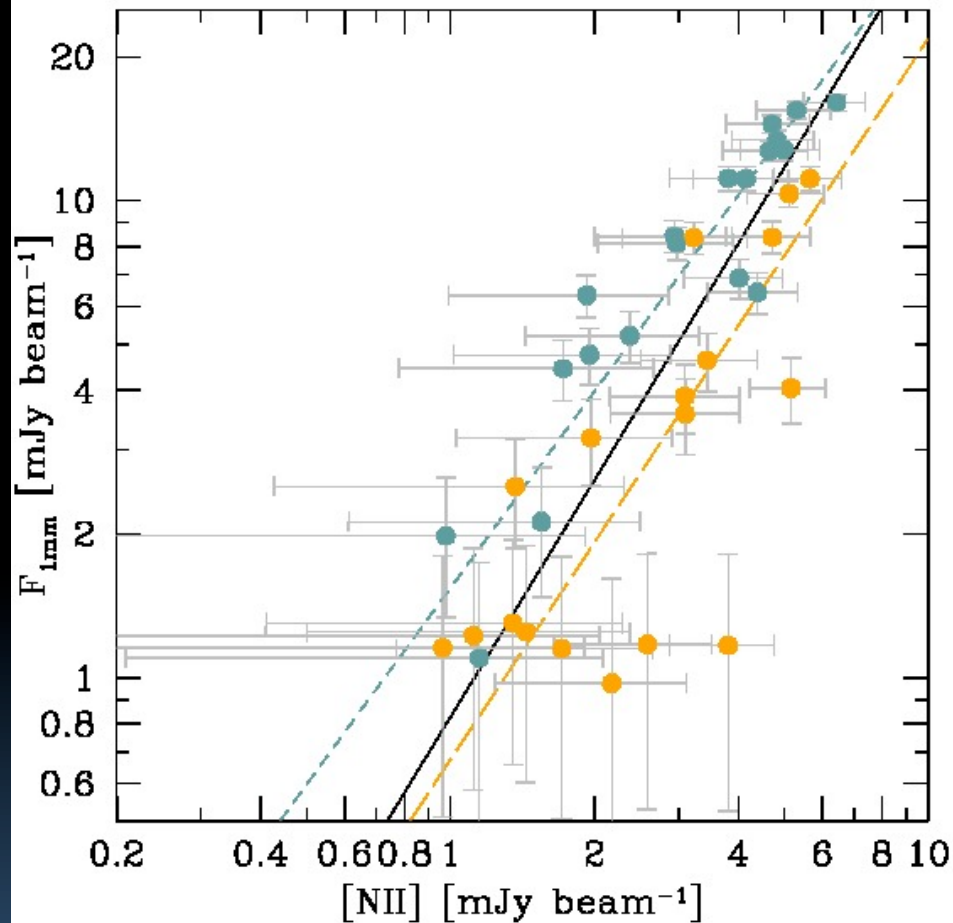
$$L_{[NII]} / L_{FIR} \sim 0.0001$$

[NII] IN MM18423+5938



[NII] IN MM18423+5938

Decarli et al. 2012



First resolved Schmidt-Kennicutt law at high-z!

CONCLUSIONS

[CII] is now “routinely” observed in FIR-bright, high- z galaxies – but not (yet) in more “normal” galaxies

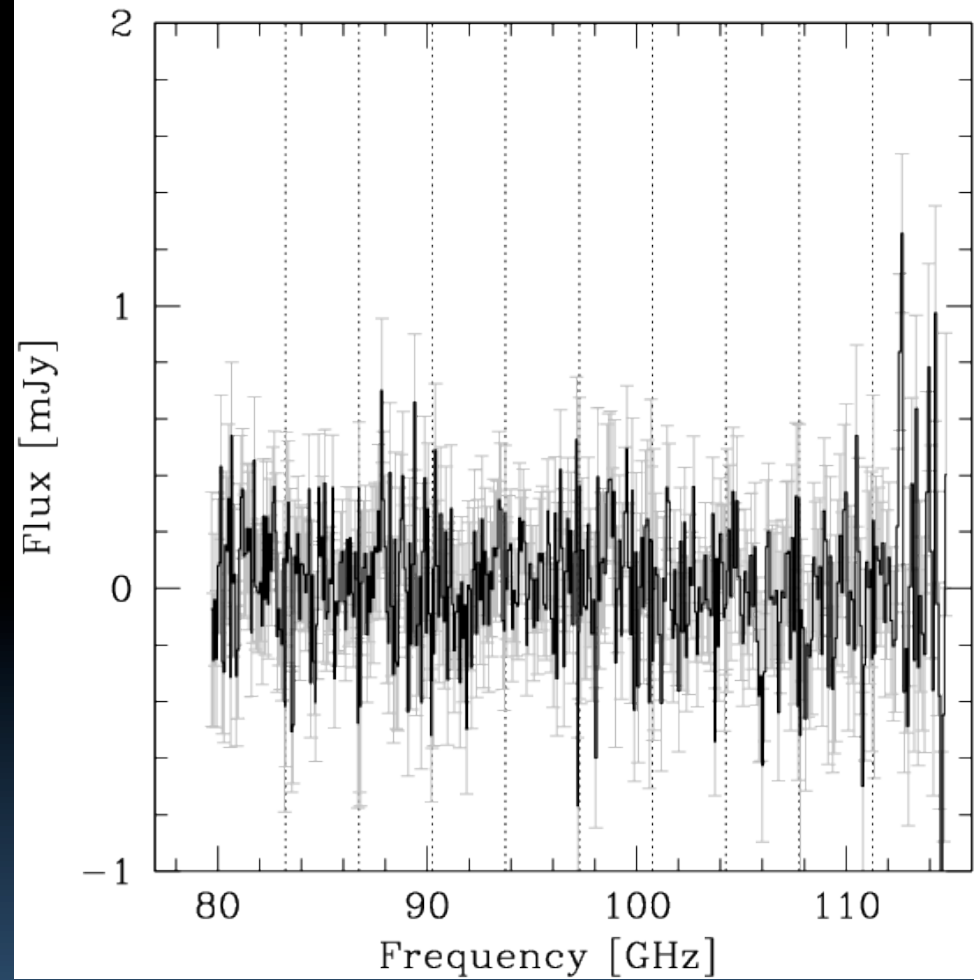
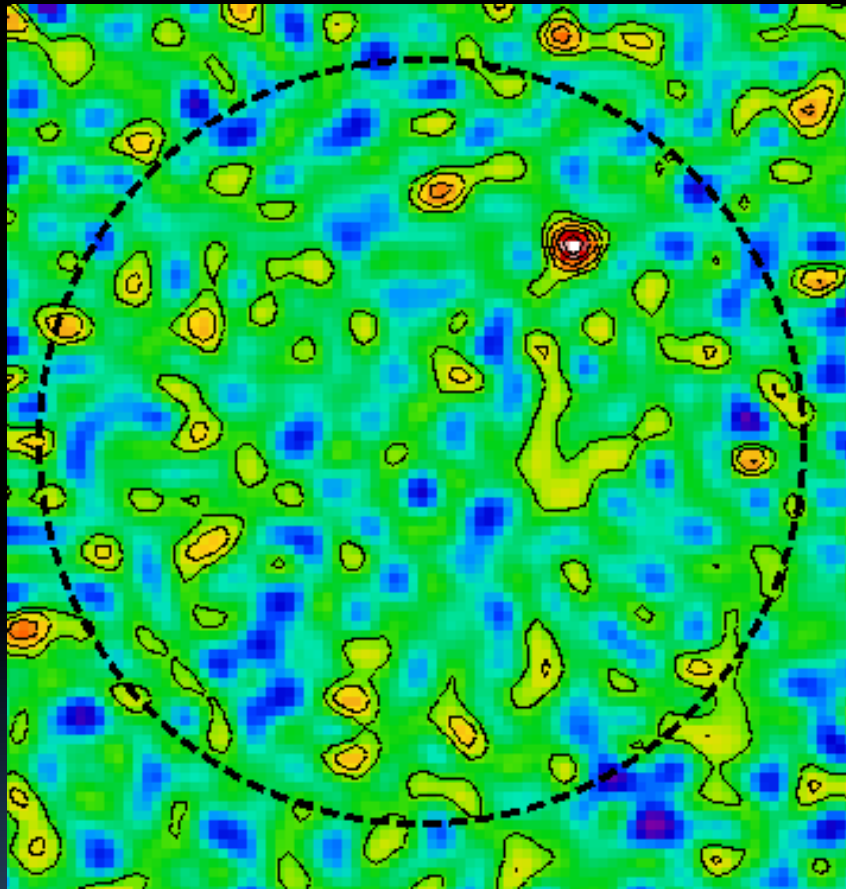
[NII] is also detected for the first time in high- z galaxies

$[NII] / [CII] \ll 10$ in SMGs and QSOs, up to ~ 0.5 in LAEs

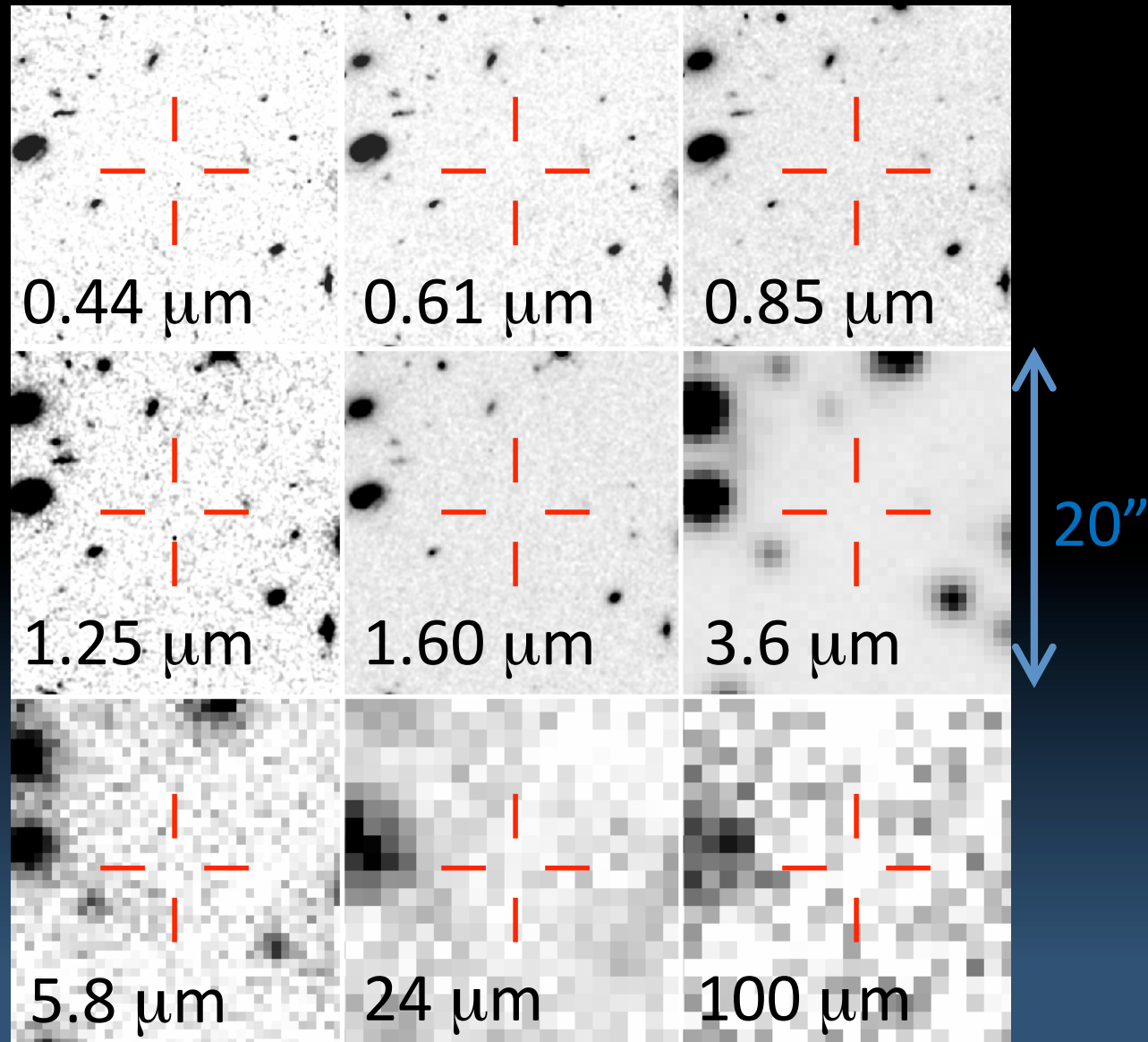
Need to increase sample sizes and line coverage



A BLIND LINE DETECTION ...



... WITH NO COUNTERPART ...



CO(3-2) at $z=2.07$ in an otherwise “dark” galaxy

(or [CII] at $z=15.87$ – ask Fred)